Catalytic performance of Yttrium-doped Co/Mesoporous Alumina Catalysts for Methane Dry Reforming

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ABSTRACT

A series of mesoporous alumina (MA) supported cobalt-based catalysts with different yttrium promoter (0-5 wt.%) loading was synthesized by sequential incipient wetness impregnation (SIWI) approach and extensively investigated for methane dry reforming (MDR) reaction. The characterization results confirmed the formation of Co 3 O 4 and CoAl 2 O 4 phases on both fresh 10%Co/MA and 3%Y 10%Co/MA catalysts. Interestingly, the average crystallite size of Co 3 O 4 was reduced by 1.63% for yttrium-doped catalyst due to dilution effect which suppresses Co 3 O 4 agglomeration. It was also found that the yttrium promoter facilitated superior metal-support interaction compared to unpromoted catalyst. The catalyst with 3 wt.% of yttrium loading exhibited the highest catalytic conversion for CH 4 and CO 2 of about 85.8% and 90.5%, respectively. This improved activity can be ascribed to excellent cobalt dispersion and stronger metal-support interaction in the presence of Y 2 O 3 promoter. Irrespective of the catalyst, the carbon nanofilaments and graphitic carbon were detected on the surface of all the used catalyst, but the quantity of deposited carbon was comparatively smaller for Y 2 O 3 promoted catalyst. This was possibly due to its high oxygen mobility attributes, which enables rapid rate of carbon removal compared to carbon deposition on the surface of catalyst.

KEYWORDS:

Mesoporous alumina; Y 2 O 3 ; Co/MA catalyst; Syngas; Methane dry reforming